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**Report on Investigations of
Use of Dead Creek as a Surge Pond
for the
Village of Sauget Sewer System**

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September 1994

**REPORT ON INVESTIGATIONS OF
USE OF DEAD CREEK AS A SURGE POND
FOR THE VILLAGE OF SAUGET SEWER SYSTEM**

By: George M. Saltwasser, Senior Consultant
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Introduction

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Horner & Shifrin has been retained by the Cerro Copper Products Company through their attorneys, Lowenstein, Sandler, Kohl, Fisher & Boylan, to investigate the use of Dead Creek as a surge pond for the Village of Sauget sewer system. The investigation has been based on information available to us from our own files, as well as information furnished to us by others for this investigation. Horner & Shifrin has extensive information in its files as a result of a long history of involvement with the Village of Sauget sewer system, both directly for the Village itself, for clients connected to the sewer system, and agencies that had a interest in the sewer system.

Some of the clients and assignments we performed are listed below.

1. In 1943 Horner & Shifrin was retained by the Lewin Metals Corporation (predecessor of Cerro Copper Products Company) to design a connection to a Village sewer from an existing sewer discharging to the Dead Creek Surge Pond.
2. In 1948, a report on the Village Sewer System was prepared for the Village of Monsanto (original name of the Village of Sauget). This report has been lost and has not been available for this investigation.
3. In 1952, a study entitled Report on Existing Sewerage System was prepared for the Village of Monsanto. This report included a recommendation for expansion of the pumping station at the lower end of the system that discharges wastewater into the Mississippi River during high river stages.

4. Another assignment in 1952 for the Village of Monsanto included preparation of design plans for expanding the pumping station at the Mississippi River from 82 cfs to a 167 cfs and preparation of design plans for two 36-inch sewer lines to the new pumping station. This work was done in conjunction with Architectural-Engineers, Inc.
5. In 1953, a small sewage pump station was designed for the sewer on Little Avenue. The client was the Village of Monsanto.
6. In 1959, a Study of Pollution Abatement for The East Side Levee and Sanitary District was prepared. This study included the Village of Monsanto. Of particular interest for the current investigation are the measurements of the flow in the Village of Monsanto outfall sewer made as a part of that Study.
7. In 1964, the Village of Monsanto retained Horner & Shifrin to prepare a report which was entitled Development of Plan of Relief for Sewer System. The purpose of the Study was to develop a comprehensive plan of relief for the existing sewer system of the Village.
8. In 1965, the Village of Monsanto retained Horner & Shifrin to design the Dead Creek Pumping Station and Interceptor which were to collect and discharge to the Village Sewer System the wastewater from the Cerro Copper Products Company (then called Cerro Corporation) that at that time was being discharged to the Dead Creek Surge Pond.
9. In 1976, Horner & Shifrin personnel designed the 36-inch D Street Sewer for the Monsanto Company. This sewer connected to the 36-inch Village sewer at a manhole identified as Manhole 2-U by the Monsanto Company. This manhole is just east of Manhole 24.

10. The Village of Sauget retained Horner & Shifrin to assist them in their industrial waste control program from 1988 to 1991. This involved acting as the Pretreatment Coordinator for the American Bottoms Regional Wastewater Treatment Plant.
11. The Village of Sauget retained Horner & Shifrin in 1992 to prepare Plans and Specifications of an outfall sewer extension and multiport diffusion system for the American Bottoms Region Wastewater Treatment Plant.

In conjunction with carrying out the various assignments listed above, we obtained a variety of information to assist us. Much of this information remains in our files. This information included reports prepared by other engineering organizations and information from the individual companies utilizing the Village Sewer System. Of particular interest to us as we made this investigation were the Reports done in 1962 by Jos. W. Goldenberg, Consulting Engineer, who prepared a Report Upon Separation of Sewers in the Village of Monsanto and a series of Reports prepared by the Monsanto Company in 1962 and 1963 which analyzed the Village of Monsanto sewer system. These reports are in our files because they were utilized in the preparation of the report prepared by Horner & Shifrin in 1964 previously listed above.

The writer of this report had a major part in the preparation of the 1964 Horner & Shifrin Report, and was the project engineer for the 1965 design of the Dead Creek Pumping Station and Interceptor.

The Village Sewer System

The Village Sewer System has been a frequently changing system to accommodate the growth and needs of the industries located in the Village. Based on information in our files, and additional information provided to us during the course of this assignment, we have been able to generally reconstruct the growth of the system so that we could investigate the use of Dead Creek as a surge pond as these changes occurred. Unless otherwise identified, numbers used to identify manholes of the Village Sewer System are those assigned to them

in the 1952 Horner & Shifrin Report and used in subsequent reports by Goldenberg, Monsanto Company (1962) & Horner & Shifrin.

In 1932 an extensive system of sewers was designed by B.C. McCurdy, Consulting Engineers. These are the first public sewers that we have a record of in the Village which was incorporated in 1926. Apparently, prior to that time, development in the area was served by sewers constructed by the individual industries and by residents of the area.

The major sewers designed in 1932 which were constructed during that year and 1933, are shown on Attachment A at the back of this Report.

In 1942 major improvements were made to the Village system. These improvements consisted of building a new pumping station at the levee, a new outfall from this pumping station to the river, and an additional 36-inch line from the pumping station eastward to a manhole now identified as Manhole 2. Other significant improvements were made in 1945. By this time a 36-inch sewer, originally used as a culvert under the Alton and Southern Railroad tracks, had been connected to Manhole No. 24 and was used as an overflow to Dead Creek. It is not clear from our information when the portion of Dead Creek south of the Alton and Southern Railroad had been blocked so that it would serve as a surge pond for this overflow but it was accomplishing this function by 1943. Attachment B at the back of this report shows the general outlines of the system as we understand it existed in 1945.

In 1948 and 1951, more additions were constructed to the Village Sewer System to significantly increase the capacity of the sewer system to transport wastewater from the southern portion of the Village. Data available confirms that the 36-inch pipe under the Alton and Southern Railroad served as an overflow and that a surge pond along 19th Street also was in use to store peak flows the sewer system could not handle. This is the basic system that existed when Horner & Shifrin analyzed the sewer system and made recommendations for more improvements in the 1952 Report on Existing Sewerage System. This system of sewers is shown on Attachment C at the back of this Report.

As a result of recommendations in the 1952 Report, the Pumping Station at the Mississippi River was essentially doubled in capacity and two additional 36-inch lines from the Pump Station to Manhole 2 were constructed in 1953, as well as some other minor sewer extensions. The improvements constructed were only a few of the recommended improvements in the 1952 Report.

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No significant additional improvements were made to the sewer system between 1953 and 1965. From 1962 through 1965, three major reports were prepared to consider future improvements to the system. In March of 1962 Jos. W. Goldenberg, Consulting Engineers, made a study entitled Report Upon Separation of Sewers in the Village of Monsanto. This Study was prepared for the Monsanto Chemical Company. In December of 1962, the engineering staff of the Organic Chemicals Division, of Monsanto Chemical Company issued Report No. 5 of Job EA No. 4-276. The stated purpose of this Report was: "To determine the adequacy of the existing Monsanto Village sewers, and where additional sewers should be located, if and when they are required..." In 1964 Horner & Shifrin was retained to prepare a report for the Village of Monsanto entitled Development of Plan of Relief for Sewer System. The major components of the sewer system as existing when these three reports were being prepared is shown as Attachment D at the back of this Report except that, in addition, the Dead Creek Pumping Station and Interceptor that were constructed in 1966 as a result of the recommendations of the 1964 Horner & Shifrin Report are also shown.

After 1966, we are aware of no substantial changes to the Village Sewer System that were made for over fifteen years. Some changes to the various industrial sewers to make it possible to measure and sample the wastewater discharge from their plants are believed to have been made and there is information indicating that the Dead Creek Surge Pond was reduced in length by blocking the culvert under Queeny Avenue around 1968 or 1969. Also during this fifteen year period, Federal and State laws required that the wastewater discharged from the Village Sewer System be treated. This resulted in major construction for wastewater treatment facilities.

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The construction of the treatment plants had an important effect on the Village Sewer System. The cost for treating wastewater and the need to control the quality of the wastewater discharged to the sewer system made it desirable and/or necessary for the industries to reduce the process wastewater they produced and discharged to the sewers.

The first treatment plant was constructed in 1967. In 1977 this plant was upgraded to meet more stringent effluent requirements including providing some treatment for stormwater. In 1987 a Regional Treatment Facility was constructed. The treated wastewater from the Village of Sauget treatment plant was required to be discharged to this facility to receive additional treatment before being discharged to the Mississippi River.

During 1984, the Monsanto Company planned to construct a 42-inch sewer to parallel the Village sewers from Manhole 19 to Manhole 26. This new sewer was designed to receive almost all of the Monsanto Company's wastewater that previously was discharged to the Village sewers in this location. The new Monsanto Company 42-inch sewer significantly increased the capacity of the Village sewers for the remaining industrial and residential flows to be discharged to them between Manhole 10 and Manhole 26.

During 1990, the Dead Creek Surge Pond north of Queeny Avenue was filled in and no longer was available to receive and/or store wastewater and/or stormwater. Cerro Copper Products Company constructed a stormwater detention basin to receive stormwater from their plant at this time.

Investigation of Potential Overflow to Dead Creek Surge Pond from 24-inch Village Sewer at Manhole 24

Period from 1953 thru 1965

A substantial amount of data is available on the Village Sewer System during this period of time. Because of this, there is the opportunity to investigate in detail the operation of the

sewer system and when overflows could, and would have occurred to the Dead Creek Surge Pond via the 36-inch overflow pipe under the Alton and Southern Railroad tracks.

As indicated above, during this time the configuration of the sewer system, as shown on Attachment D, remained relatively constant. Data in the various reports available document the wastewater and stormwater flows discharged to the sewer system from the various industries and the residential area did not vary substantially between 1960 and 1964. It seems reasonable to assume that this was essentially true for the entire time period.

The 1962 Monsanto Chemical Company Report analyzed the Village Sewer System under a variety of flow conditions, one of which was considered to be the existing average dry weather flow (55.3 cfs). Other reports analyzed the system under dry weather flow but for projected future peak flows rather than existing flows. Since the Monsanto Report used existing dry weather flow, this analysis is particularly helpful and is discussed below.

This Monsanto Company analysis concluded that the 24-inch Village sewer at the junction with the 36-inch overflow to Dead Creek (Manhole 24) would not discharge to Dead Creek during average dry weather flow but that the water surface would be right at the elevation where discharge to Dead Creek could start. The flows used in this analysis were consistent with the average weekday flow measurements as reported in the 1959 Horner & Shifrin report (36.2 mgd or 56.0 cfs) prepared for The East Side Levee and Sanitary District but not the peak dry weather flows that were recorded. These measured peak dry weather flows (39.2 mgd or 60.6 cfs) recorded by Horner & Shifrin were approximately 10% higher than the average flow.

The basis of the hydraulic computations, i.e., the "n" value for pipe frictional computations used in the Monsanto Company Report, was questioned by Metcalf & Eddy, Engineers, in a Report for the Village of Monsanto dated March 5, 1965 entitled Conveying of Storm and Waste Water from the existing Village Pumping Station to the Proposed Corps of Engineers Pumping Station. Metcalf and Eddy expressed the opinion that the value used in the Monsanto Company Report resulted in calculating too little friction in the sewer system.

Based on Metcalf & Eddy's evaluation, the hydraulic gradient would be between two feet and three feet higher at Manhole 24 than indicated in the Monsanto Company Report. This increase would make it possible for dry weather wastewater from Manhole 24 to overflow to Dead Creek.

Flow measurement made by Rickman, Egerly, Burbank & Associates in 1962 provided data that seems to confirm the Metcalf & Eddy evaluation that pipe friction calculated in the Monsanto Report was too small. Hydraulic gradients at Manhole 19, with flows in the 24-inch and 30-inch sewers comparable to those used in the Monsanto Company Report, indicated the measured hydraulic gradient in the 24-inch sewer was higher than calculated in the Report by 10-inches to 12 inches. Part of the increased hydraulic gradient in the 24-inch sewer was due to the split in flow between the 30-inch sewer and the 24-inch sewer.

Computations made during the course of this investigation also confirmed the conclusions expressed in the Metcalf and Eddy Report. These computations indicate a calculated depth at Manhole 24 that is 12 inches higher for the same flows used by the Monsanto Co.

On November 8, 1965 during a period without substantial rainfall in the area, the hydraulic gradient in Manhole 24 was measured by Horner & Shifrin personnel to be 24-inches above the bottom (invert) of the 36-inch sewer to Dead Creek. This hydraulic gradient was thought by Monsanto Company to be caused by deposits in the 24-inch Village sewer and that cleaning the sewer would lower the hydraulic level at Manhole 24. Whatever the reason for the observed condition, this demonstrates that the water surface actually attained an elevation in the Village sewer during dry weather that could cause overflow to Dead Creek through the 36-inch sewer.

Finally, in a letter dated November 13, 1964 from Mr. Silverstein of Cerro Corporation to Mr. Goldenberg, Mr. Silverstein stated, "Dead Creek has been used for ponding and surge storage for a number of years and the vast majority of the time the level of Dead Creek is very close to the top of the 36-inch conduit which connects it with the Village sewers...."

In order for flow to go from Manhole 24 through the 36-inch overflow into the Dead Creek Surge Pond, two conditions must occur:

- 1) The hydraulic gradient (water surface level) in Manhole 24 must be above the highest point of the bottom (invert) of the 36-inch pipe; and
- 2) The water level in the Dead Creek Surge Pond must be below the hydraulic gradient in Manhole 24.

During the time period being considered, under average dry weather flow, some of the wastewater from the Cerro Copper Products plant was entering the Dead Creek Surge Pond and flowing into the Village Sewer System through the 36-inch pipe from the Dead Creek Surge Pond to Manhole 24. A flow of 2.6 cfs from Cerro Copper Products is the value used by Monsanto Company and we concur is an appropriate value to use.

An investigation was made to determine what the water level would have to be in the Dead Creek Surge Pond to allow this 2.6 cfs of Cerro flow to enter the 36-inch sewer. Two different conditions were investigated:

1. Assuming the water level in Manhole 24 is 10.5 inches higher than the invert elevation of the 36-inch overflow at Manhole 24 (6 inches above the invert elevation of the 36-inch overflow in the south end).
2. Assuming the water level in Manhole 24 is 13.5 inches higher than the invert elevation of the 36-inch overflow at Manhole 24 (9 inches above the invert elevation of the 36-inch overflow on the south end).

The Hydro Calc Circular Channel Analysis Computer Program Version 1.5 by Dodson and Associates was used for the computations.

Condition 1 assumes the water level in Manhole 24 is about 6 inches higher than computed in the Monsanto Company Report. Condition 2 assumes the water level is 9 inches higher than computed in the Monsanto Company Report.

Under Condition 1, the water level in the Dead Creek Surge Pond would have to be about 3 inches higher than the water level in Manhole 24 to allow the 2.6 cfs flow from Cerro to enter Manhole 24.

Under Condition 2, the water level in the Dead Creek Surge Pond would have to be only about 1 inch higher than the water level in Manhole 24 to allow the 2.6 cfs flow from Cerro to enter Manhole 24.

Under these conditions, even a minor increase in the flow to the Village system of 3% or less would make the wastewater hydraulic gradient (water level) in Manhole 24 rise above the elevation in the Dead Creek Surge Pond and the direction of the flow would reverse and go from Manhole 24 to the surge pond. The rate of flow into the Dead Creek Surge Pond would depend on how high the water level in Manhole 24 got in relation to the water level in the surge pond.

It should be noted that if the hydraulic grade in Manhole 24 constantly stayed at a high elevation, e.g., the elevation noted on November 8, 1965, the flow out of Manhole 24 and the Cerro plant flow into the Dead Creek Surge Pond would raise the water level in the surge pond until eventually the flow from Manhole 24 would stop and the flow from the Dead Creek Surge Pond would again start entering the 36-inch pipe.

Based on the above information, it is clear that during the time period from 1953 to 1965 conditions could and did exist for dry weather flow from the Village sewer at Manhole 24 to enter the Dead Creek Surge Pond from time to time. Although conditions could exist at any time for this to happen, one obvious scenario would be for the water surface in Manhole 24 to be 9 inches or more above the high point of the invert elevation of the 36-inch pipe into the Dead Creek Surge Pond due to normal dry weather flow into the Village Sewer System.

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The level in the Dead Creek Surge Pond would be about 1 inch higher to allow the flow from the Cerro plant to flow through the 36-inch sewer to the Village Sewer. During the weekend when the records indicate the flow discharged into the Village system would decrease, the water level in Manhole 24 would drop by about 12 inches. With this change, the stored liquid in the Dead Creek Surge Pond would start to enter the Village sewer and the water level in the Dead Creek Surge Pond would drop. On the following Monday when the flow increased in the Village Sewer System, the water level in Manhole 24 would rise again and flow would go from Manhole 24 to the Dead Creek Surge Pond. As the level in the Dead Creek Surge Pond increased due to the flow entering it, the flow out of the Village Sewer System would decrease and eventually stop and then reverse to let flow from Cerro again enter into Manhole 24.

A change from average flow in the Village Sewer System to a period of normal daily peak flow could also cause the hydraulic grade in Manhole 24 to rise sufficiently to cause the flow in the 36-inch pipe to reverse and discharge into the Dead Creek Surge Pond during the peak flow occurrence.

During periods of rainy weather, stormwater entered the sewer system. The rate of stormwater entering the Village sewers would depend on the amount of rain that occurred and the ability of the sewers to accept the additional flow over and above the dry weather flow it carried. Every study of the Village Sewer System we reviewed recognized that the system was inadequate for handling runoff from even moderate rainfall events without the use of surge ponds.

Normally, analyses are made for sewers serving this type of industrial area on the basis of a rainfall event that would occur on an average once every five years. The 1952 and 1964 Horner & Shifrin Reports and the 1962 Goldenberg Report used this criteria. Other factors for design include the area that would drain to the sewer and the imperviousness (character of the surfaces) of the area, and the time for the peak flow to occur. These factors result in a "PI" (also called "CI") value that indicates the amount of stormwater runoff from a specific

area. It is expressed in cubic feet per second per acre. The larger the area, the greater the rate of runoff.

In the 1962 Monsanto Company Report, they developed data for different rainfall/runoff conditions. Although the hydraulic computations of this Report are subject to the questionable "n" factor used as discussed previously, it is of interest to note that for one condition that was studied, a "CI" factor of 0.5 was used and it was concluded that "Dead Creek would receive a flow of 17 cfs from the south area with the water level reaching elevation 400.8 in 180 minutes". For a second condition a "CI" factor of 0.75 was used and it was concluded, "The south sewers discharge 39.5 cfs to Dead Creek where the water level will reach elevation 399.6 in 45 minutes". For a third condition a "CI" factor of 1.0 was used and it was concluded, "The south sewers are adequate, with a discharge of 54 cfs to Dead Creek where the water level reaches 399.8 in 45 minutes". Neither Horner & Shifrin nor Goldenberg agreed that the "CI" factors used by Monsanto Company in their Report represented large enough rates of stormwater runoff to be classified as a once in 5 year event; however, this Report does clearly show that during rainfall events, flow would enter the Dead Creek Surge Pond from Manhole 24. Some of the differences in the Horner & Shifrin and Monsanto Company evaluation of the appropriate "CI" factor to use is discussed on page 9 of the 1964 Horner & Shifrin Report.

The significant use of Dead Creek as a surge pond was expressed in the 1964 Horner & Shifrin Report (page 12) which stated, "Should the surge ponds no longer be permitted to receive polluted wastewater, yet maintaining the existing combined sewer system, all of the main sewers would require extensive supplementation. The most grossly overloaded section would be that through the Monsanto Company property between Mississippi Avenue and the north end of the Dead Creek channel".

To obtain a perspective of how often rainfall events would cause overflow into the Dead Creek Surge Pond, the measurements of flow made in 1959 for The East Side Levee and Sanitary District Report are helpful. During six weeks of measurement in the fall of 1958, precipitation occurred on 9 days. On the three days of greatest rainfall the total precipitation

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did not exceed 1-inch for the entire day. (For comparison, a 1 Year Frequency storm of only 1 hour duration would have 1.35 inches or a 1 Year Frequency storm of 6 hour duration would have 2.12 inches. See Technical Paper No. 40 of US Weather Bureau). The effect of the precipitation can be identified by substantial increased flow in the sewers. On all three days the flow peaked at rates over 77 cfs (50 mgd) and once over 91 cfs (59 mgd). These rates of flow clearly would cause overflow into the Dead Creek Surge Pond considering that the system would only handle around 55 cfs without overflow as illustrated in the discussion of the dry weather flow conditions. Obviously, an overflow into the Dead Creek Surge Pond from Manhole 24 occurred many times in a year during the occurrence of rainfall. This conclusion is in full accord with the statement in the 1964 Horner & Shifrin Report (page 2), "Almost all of the system is surcharged during periods of moderate rainfall runoff and would be completely inadequate if two surge ponds were not presently available for the temporary storage of that portion of the flow which cannot be accommodated by the sewers".

It is appropriate to note that during the early 1960's, the Monsanto Company was very insistent that Dead Creek continue to be used as a surge pond to receive excess flows that the Village Sewer System could not handle during peak flows.

The Monsanto Company Report of December 1962 stated, "2. Elimination of Dead Creek and 19th Street pond facilities would require the addition of at least two new 60-inch sewers to carry storm runoff. It is not recommended that this be done at the present time".

After the completion of the 1964 Horner & Shifrin Report, the discussion of the recommendations of the Horner & Shifrin Report to eliminate Dead Creek as a surge pond for polluted wastewater indicated opposition from the Monsanto Company. In the minutes of a meeting of the Village industrial representative on June 8, 1965, it is stated, "Because of the general opposition of those present other than Stutz & Hodges (Monsanto Company representatives) to the Monsanto recommendation for the use of surge ponds, it was proposed that the plant managers of the Village Industries meet and see if a Village sewer policy can be formulated".

The minutes of a second meeting on June 14, 1965 indicate the firm commitment Monsanto Company representatives had to the concept that Dead Creek remain in use as a surge pond. One of five Monsanto Company proposals that were presented as an effort "to break the deadlock" was: "(4) Provide an additional relief line from the Village sewers at the south end of the Monsanto Plant under the A&S tracks into Dead Creek..."

Cerro Corporation was in opposition to the policy of using Dead Creek as a surge pond. Mr. Silverstein of Cerro Corporation stated in a letter dated November 23, 1964 to Mr. Goldenberg, "We therefore believe that any changes or modifications of the present (Village) waste disposal system should be taken in steps towards a direction that will eliminate the obnoxious environment of Dead Creek rather than contributing to it". The minutes of the two meetings of industrial representatives in June of 1965 reiterated the position of Cerro that Dead Creek should not be used as a surge pond. The minutes of the June 14, 1965 meeting record the following, "S. Silverstein restated Cerro's position that they believe the Village would have to eventually cease ponding of polluted wastes".

Period from 1966 to 1984

In 1966, the Dead Creek Pumping Station and Interceptor were constructed. These facilities were designed to remove Cerro Corporation's wastewater from the Dead Creek Surge Pond and discharge it into the 36-inch sewer going under the Alton & Southern Railroad tracks. Originally, it was the design concept to pipe the wastewater under the railroad tracks to a sewer on the north side of the railroad tracks. The design was modified at the request of the Monsanto Company. (See letter dated November 10, 1965 from George Salwasser of Horner & Shifrin to Joseph Goldenberg.) The connection to the 36-inch overflow line was designed to allow the overflow of wastewater from Manhole 24 to Dead Creek to continue but the elevation that the overflow could start was raised 10 inches.

About this time (1966), the various industries started to implement process changes that reduced the quantity of wastewater discharge to the Village Sewer System. The impetus for this was the requirement for wastewater treatment of the flow from the Village outfall. For

example, the Monsanto Company average dry weather flow to Manhole 19 in 1962 was listed as 31.6 cfs or 14,000 gpm. In 1972, the total flow from Monsanto Company was reported to be "slightly more than 7,000 gpm" and as of January 1, 1975, "...flow reduction projects were completed...reducing the total plant flow to 4,870 gpm." The data quoted is from Appendix A of a 1974 Year-End Status Report dated February 6, 1975 by M.R. Foresman of the Monsanto Company (CER 106705).

In 1970 Biodize System, Inc. was retained by the Village to measure and sample the flows from the various industries for the purpose of distributing the operating costs of the Village Treatment Plant among the various contributors. This report, dated December 1970, indicated that the total average wastewater flow was 23.836 mgd (36.8 cfs). In a report entitled Addendum to Facilities Plan and Infiltration - Inflow Analysis (Table 3, page 16) by P.H. Wels & Associates, Inc. and Rhutasel & Associates, Inc. dated February 1984, the average day dry weather flow to the Village treatment plant for 1983 was reported to be 8.33 mgd (12.9 cfs).

Because of the reduced dry weather flows discharged to the Village sewers, the Village Sewer System would have had capacity to discharge the dry weather flow without any expectation of a discharge to the Dead Creek Surge Pond. This assumes the sewer lines between the pumping station at the river and Manhole 24 were capable of operating at essentially their original capacity. The decreased dry weather flow also provided more capability for the transportation of stormwater flows before overloading the sewers to the extent that flow from Manhole 24 would discharge to the Dead Creek Surge Pond. This increased capacity available for stormwater flow would reduce the number of wet weather overflows into Dead Creek.

In 1981 when repairs to a manhole near Route 3 were necessary, P.H. Wels & Associates studied the effect of needing to close off one of the two sewers downstream of Manhole 21 to accomplish the repairs. There was a discussion about the capacity of one sewer to handle stormwater flows. In a letter report dated June 26, 1981 (CER 099669), Paul Wels wrote that whether one or two sewers was operating would have essentially no effect during a 20-year rainfall event since with both sewers operating with a hydraulic grade just at the overflow level

to Dead Creek, the stormwater runoff would be 10 times the capacity of the sewer. Based on this computation by Mr. Wels, it is obvious that a 1-year rainfall event, which would produce approximately 40% of the runoff of a 20-year event, would produce a stormwater runoff essentially four times the capacity of the two sewers (even without any dry weather flow) and therefore, there would be an overflow to the Dead Creek Surge Pond to take some of the excess flow.

Reviewing the data from the 1959 flow measurement previously mentioned, indicates that on the three days when rainfall caused significant increases in flow, the increased flow due to stormwater was 17 mgd (26 cfs), 20 mgd (31 cfs), and 31 mgd (48 cfs). It appears that the two smaller rainfall events might have been able to be transported by the Village Sewer System, but that the third rainfall event would have caused an overflow into the Dead Creek Surge Pond. This assumes no material change in the stormwater directed into the Village sewer between 1959 and 1981.

The data available indicates that during the period from 1966 to 1984, the occasions of overflow to Dead Creek decreased. Dry weather overflows into Dead Creek may have occurred during the first year or two, but by 1970 and thereafter, no overflows from Manhole 24 appear to have occurred during dry weather as long as the sewer system was functioning properly. During the 1982 flood season (which was a record flood at the time) the sewer system did experience substantial damage, but there is no information available to us to indicate that the sewers failed to function to adequately conduct the dry weather flow to the treatment plant or that any dry weather flow overflowed to the Dead Creek Surge Pond.

It is clear that the stormwater flows that resulted from even moderate rainfall continued to produced flows that the Village Sewer System could not handle without overflows from Manhole 24 to the Dead Creek Surge Pond. The frequency of overflows would have decreased over this time period due to the capability of the sewer system to receive more stormwater because the dry weather flow had decreased substantially. The deterioration of the sewer system during and after 1982 may have increased the occasion of overflow during

rainfall because of decreased sewer capacity due to the damage sustained by the sewers in the 1982 flood.

Period from 1985 to 1990

During this period of time, Monsanto Company constructed a 42-inch sewer to parallel the Village sewers from Manhole 10 to Manhole 28. During 1990, the Dead Creek Surge Pond was filled in and was no longer available to receive overflows from Manhole 24.

Little information is available to us about this time period, but after the 42-inch sewer was constructed by Monsanto, overflows to the Dead Creek Surge Pond were likely to occur only during significant rainfall events.

Information that during rainfall events overflows to the Dead Creek Surge Pond did occur as late as 1990 is provided from the records of the Korte-Plocher Construction Company. On June 6, 1990 and again on August 15, 1990, while constructing the stormwater detention facility for Cerro Company, the Superintendent recorded on his Daily Job Report that "water from Monsanto" was coming into his work area for the Cerro project after rain started falling.

Period Prior to 1953

Not a lot of detailed information is available during this period but we have included the following information we do have to cover the entire period that the Village Sewer System existed as well as some time before this.

The 36-inch line under the Alton and Southern Railroad track was constructed in 1924 or 1925 to replace a trestle for the tracks across Dead Creek. Dead Creek was originally a free flowing drainage ditch flowing from north to south. It terminated in Cahokia Chute, a small channel of the Mississippi River around Arsenal Island. It extended northward into the City of East St. Louis and beyond. The Railroad installed the pipe, but by agreement with Monsanto

Company, the elevation of the new 36-inch pipe was placed below the bottom of Dead Creek to allow the existing Monsanto sewer pipe upstream to drain through the Railroad's 36-inch pipe.

By the early 1930's Dead Creek had been filled in south of Monsanto Avenue and buildings of the Monsanto Company erected on the fill. The 36-inch line under the Alton and Southern Railroad track provided for drainage of stormwater from the area between Monsanto Avenue and the Alton and Southern track to continue to drain southward through Dead Creek. Since there are no records of sewers in the area prior to 1932, it seems likely that before the Village Sewer System was constructed, the industries located along Dead Creek south of Monsanto Avenue discharged wastewater flows into Dead Creek to drain to the Mississippi River.

The Village Sewer System design by B.C. McCurdy in 1932, shown in Attachment A, did not show any connection between the existing 36-inch pipe and the proposed Village Sewer System, although an 18-inch sewer from Mississippi Avenue to Dead Creek was designed and constructed just south of what is now Queeny Avenue and labeled as an overflow line. No detailed information is available on how the industrial sewers were connected to the Village system after it was constructed, but it is apparent that stormwater runoff, with or without being mixed with the industrial wastewater being produced in the area, had to be discharged to Dead Creek because of the inadequacy of the Village sewers to receive any substantial amount of stormwater runoff. In the custom of this time and place, the industrial wastewater and stormwater runoff frequently discharged to a single system of sewers with some provision for the sewers to discharge some of the combined wastewater and stormwater to drainage ditches during wet weather when stormwater flows occurred. It seems likely that industrial wastes were allowed to discharge to Dead Creek from time to time.

In 1935 a drawing of the Village Sewer System was prepared to indicate the capacity of the various Village sewer lines. This map does not show the 36-inch sewer under the railroad tracks or give any indications of an overflow from the 24-inch sewer Village line to Dead Creek.

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The earliest indication available to us that the Village sewers were connected to the 36-inch line to Dead Creek is 1943. A survey had been made for an extension of a Lewin Metals Corporation (now Cerro Copper Products Company) sewer to connect it to the Village Sewer System east of Dead Creek, just south of the Alton and Southern Railroad. This survey shows the water surface in Dead Creek to be identical with the hydraulic gradient in the Village sewers, indicating that the two were connected. Subsequent to this, numerous drawings are available which shows the connection between the two. This information is consistent with the fact that in 1939 the Alton and Southern Railroad granted the Village permission to extend the original 36-inch pipe under the railroad tracks northward to connect to the 24-inch Village sewer.

The portion of Dead Creek between the Alton & Southern Railroad tracks south to Judith Lane was converted to a pond by blocking the flow under Judith Lane. When this was done has not been determined but by 1943 the Creek bed was accomplishing this because the water level in Dead Creek was approximately 2 feet higher than the culverts that otherwise would allow Dead Creek to drain to the south. The blockage at Judith Lane may have been accomplished at the same time the 36-inch line under the Railroad tracks was connected to the Village Sewer System.

We are not aware of any detailed information about dry weather flow during this period. The 1952 Homer & Shifrin Report discusses dry weather flows but only in the context of future flows to be used for design of additions to the sewer system in contrast to existing dry weather flows.

The 1943 survey indicates that the level in Dead Creek was 2 feet above the invert elevation of the 36-inch sewer. This indicates that this part of Dead Creek was serving as a surge pond for dry weather flow at this time. The multiple additions (1942, 1945, 1948 and 1951) to the original sewer system built in 1932 indicate that the system was not adequate for the growing use of the system. The extent to which Dead Creek operated as a surge pond during dry weather flows can only be a speculation with the information we have, but it seems evident that it did. This would be the explanation for the decision to convert the 36-

inch line under the Alton and Southern Railroad from a culvert to handle stormwater in Dead Creek to an overflow line for the 24" Village Sewer.

After the 36-inch line under the railroad tracks was connected to the Village Sewer System there was no outlet for stormwater north of the tracks to be drained out of the area except through the Village Sewer System. Since the 24-inch sewer could not begin to provide adequate capacity for this, any significant stormwater flow entering the original 24-inch Village sewer, even after being supplemented by the 30-inch sewer in 1945, would have had to overflow at Manhole 24, through the 36-inch line into Dead Creek.

The 1952 Horner & Shifrin Report stated that the then existing Village Sewer System was capable of discharging 76 cfs to the Pumping Station at the river. This analysis was based on allowing the water level in Manhole 25 to rise to a level more than 5 feet above the top of the 24-inch sewer. This elevation would only be attainable if the 36-inch overflow to the Dead Creek Surge Pond were not available. (The premise of the Horner & Shifrin analysis and recommendations was that there would be no connection from the Village Sewer System to Dead Creek.) Since the overflow was in existence and had been for at least 9 years, a flow of 76 cfs into the Village Sewer System would cause an overflow into the Dead Creek Surge Pond from Manhole 24. It was estimated that the amount of stormwater reaching the Village sewers at that time as a result of a 5-year frequency storm was 100 cfs (page 7). Based on this data, a 1-year frequency storm would produce on the order of 60 cfs of stormwater runoff. A flow of less than 50 cfs would cause the hydraulic gradient at Manhole 24 to be about 1 foot above the bottom of the 36" overflow to the Dead Creek Surge Pond and therefore could allow an overflow to Dead Creek Surge Pond.

From the above data, it is obvious that prior to 1952 there had been overflows into Dead Creek during wet weather.

It is our conclusion from the information available that prior to 1932, wastewater from the industries in the Village along Dead Creek discharged these wastes to Dead Creek and flowed southward eventually reaching the Mississippi River. After the Village Sewer System

was constructed in 1932 and the connection made to the 36-inch pipe under the railroad track around 1939, it is reasonable to assume that there were times when the dry weather wastewater flow entered Dead Creek which was blocked to create a surge pond. The water level of Dead Creek shown on the survey made in 1943 indicates this, but no specific data confirms it. The repeated expansion of the system confirms there was a need to increase the capacity of the sewer system, but not necessarily to handle the dry weather flow.

Stormwater flow mixed with industrial wastewater would have entered Dead Creek during the period from prior to the construction of the Village Sewer System through 1952. The need to expand the system repeatedly certainly indicates this. During and immediately prior to 1952, the data available validates this conclusion for that specific period of time.

Summary of Conclusions

History of Dead Creek within the Village of Sauget

Dead Creek originally was a free flowing creek originating north of the Village of Sauget, flowing southward through the Village and continuing flowing generally southward about 5 miles to discharge into the Mississippi River at Arsenal Island.

In 1924 or 1925 a 36-inch culvert was installed under the Alton and Southern Railroad tracks to replace a wooden trestle. The Monsanto Company entered into an agreement with the Alton and Southern to install this new culvert below what was then the bottom of Dead Creek so that a sewer from the Monsanto Company into Dead Creek could drain through the new culvert. The change from a trestle to the 36-inch pipe which had much less capacity probably was due to the fact that part of Dead Creek north of the Alton and Southern tracks was filled in and the drainage that had gone to Dead Creek from north of Monsanto Avenue no longer entered Dead Creek. This was certainly the condition by the early 1930's at which time the Dead Creek channel had been filled in for about 1,000 feet south of Monsanto Avenue and used by the Monsanto Company for building sites.

After 1939, or shortly thereafter, when the 36-inch pipe under the Alton and Southern tracks was connected to the Village Sewer System at Manhole 24, all drainage due to rainfall from north of the tracks was eliminated from flowing southward under the tracks, except what entered the Village Sewer System and overflowed through the 36-inch pipe under the tracks.

At some time not know exactly, Dead Creek south of the Alton and Southern tracks was blocked at Judith Lane. It would seem reasonable this would have been done in 1939 when the 36-inch pipe under the railroad was connected to the Village Sewer System. By 1943 this part of Dead Creek was acting as a pond with a connection to the Village Sewer System which controlled the water level in the pond.

Sometime in the middle or late 1960's the pipe under Queeny Avenue was plugged which reduced the length of the pond that was connected to the Village Sewer System. In 1990 the channel of Dead Creek between the Alton and Southern Railroad and Queeny Avenue was filled in as part of the clean-up of Dead Creek known as Hazardous Waste Site CS-A.

Wastewater Discharges to Dead Creek and Dead Creek Surge Pond within the Village of Sauget During Dry Weather

Prior to the construction of the initial Village Sewer System in 1932 and 1933, industries in the Village along the channel of Dead Creek discharged their wastewater into Dead Creek. No information is available about sewage from homes in the area. After the Village Sewer System was constructed, both the industrial and residential wastewater were discharged to this sewer system except for Lewin Mathes Company (a predecessor company to Cerro Copper Products Company) which continued to discharge some of its wastewater to Dead Creek. Some other industries south of the Alton and Southern Railroad may also have discharged some wastewater to Dead Creek. Prior to 1939 all wastewater discharges to Dead Creek would have flowed southward to the Mississippi River. No information is available on whether or not any wastewater from the industries connected to the sewer system entered Dead Creek at this time during dry weather due to inadequate capacity of the Village Sewer System.

By 1943, after the 36-inch pipe under the Alton and Southern Railroad was connected to the Village Sewer System and the Dead Creek channel was acting as a pond, it served as a surge pond for the Village Sewer System as well as a channel to conduct into the Village Sewer System wastes discharged directly into it. There is no detailed information available about dry weather flow to document what happened between 1939 and 1952. Since the Village Sewer System also changed frequently, the circumstances for creating overflows into the Dead Creek Surge Pond would have varied during this time. For these reasons, we cannot reconstruct what happened with regard to dry weather overflows to the Dead Creek Surge Pond during this period.

During the period from 1959 to 1965 substantial information is available. Furthermore, the Village Sewer System remained essentially unchanged. The data clearly indicates that Dead Creek served as a surge pond for overflows from the Village Sewer System via the 36-inch sewer under the Alton and Southern Railroad between Manhole 24 and the Dead Creek Surge Pond. Both hydraulic computations and actual observations substantiates this statement. Some wastewater from the Cerro plant continued to be discharged to the Dead Creek Surge Pond.

The Dead Creek Surge Pond was overtly considered a part of the Village Sewer System.

In 1966 the direct discharge of wastewater by Cerro Corporation into the Dead Creek Surge Pond was eliminated by the construction of the Dead Creek Interceptor and Pump Station. The overflow from the Village Sewer System, which then would have included the wastewater from Cerro that previously had been discharged directly to Dead Creek, would have continued to enter the Dead Creek Surge Pond from time to time due to a variety of circumstances. These dry weather overflows would have decreased in number after 1966 because the dry weather flow to the Village Sewer System started to decreased around 1967 from about 55 cfs to 36.8 cfs in 1970 and 12.9 cfs in 1984. It seems reasonable to assume that after 1970 no dry weather flows entered the Dead Creek Surge Pond except under unusual conditions., e.g., unusually large flows or maintenance of the sewer system. By 1990 the surge pond had been filled.

Information on Wastewater Discharges to Dead Creek and Dead Creek Surge Pond within the Village of Sauget During Wet Weather

Prior to the construction of the Initial Village Sewer System in 1932 and 1933, all industrial wastes from industries along the channel of Dead Creek were discharged to Dead Creek in both wet weather as well as dry weather. After 1932 and up to 1939 no specific information is available but probably industrial wastes and rainfall runoff were collected in the same sewer system within the boundaries of the various industries. Since the Village Sewer System did not have capacity for much, if any, rainfall runoff, the industrial sewers would have had to overflow to Dead Creek during wet weather. These overflows would have been a combination of stormwater and industrial wastes and would have flowed southward through Dead Creek to the Mississippi River. The 18-inch sewer line from Mississippi Avenue to Dead Creek, installed in 1932 as part of the Village Sewer System, would have served this purpose for the industries along Mississippi Avenue.

About 1939, after the 36-inch line under the Alton and Southern was connected to the Village Sewer System at Manhole 24, the 36-inch sewer under the Alton and Southern Railroad would have served the same purpose as the 18-inch sewer line to discharge a combination of industrial wastes and stormwater runoff to Dead Creek.

By 1943 when Dead Creek was blocked from flowing southward to the Mississippi River, Dead Creek was acting as a surge pond. How often the combined stormwater and industrial wastewater overflowed up until the late 1940's is not known because the information on the dry weather flows and the amount of rainfall runoff reaching the sewers is not known. Because of the limited capacity of the Village Sewer System and the desire to utilize the 36-inch sewer under the Alton and Southern Railroad as an overflow for the Village Sewer System, it is likely that an overflow occurred even during minor rainfall runoff events.

In 1951 additional sewers along Mississippi Avenue south of the Alton and Southern Railroad and to a point south of Queeny Avenue were constructed. At this time, the 18-inch overflow line from Mississippi Avenue was connected to the Village Sewer System so that normally

only stormwater would be discharged to Dead Creek and the industrial wastewater was discharged northward and stayed in the Village Sewer System.

Detailed data available for 1952 and the years immediately before this indicate that rainfall events of less than 1 year frequency would cause overflows to the Dead Creek Surge Pond through the 36-inch pipe under the Alton and Southern Railroad.

The substantial data available on the Village Sewer System from 1953 to 1965 makes it clear that rainfall events of a minor nature occurring many times a year, caused overflows into the Dead Creek Surge Pond. The Dead Creek Surge Pond was overtly considered a part of the Village Sewer System and essential to preventing flooding of plant sites during rainfall events. The continuation of this design concept was advocated and endorsed by Monsanto Company because it eliminated the need to construct extensive improvements to the Village Sewer System.

After 1966 when the dry weather flows into the Village Sewer System started to decrease the Village Sewer System had more capacity to receive stormwater flow. For this reason stormwater overflows would have decreased in frequency but even moderate rainfall events would have continued to cause overflows to the Dead Creek Surge Pond.

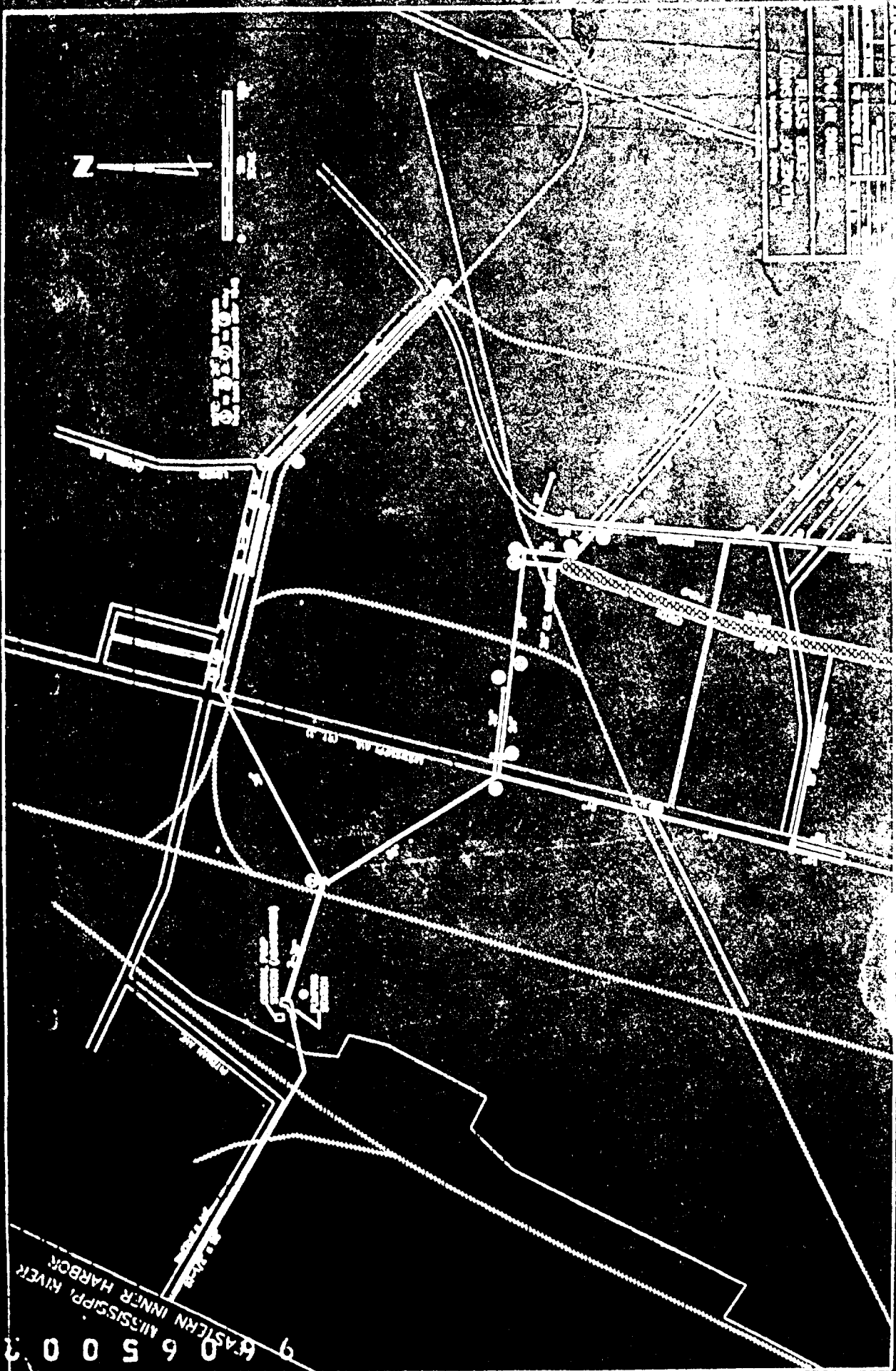
After 1984, increased sewer capacity further reduced the frequency of overflows to the Dead Creek Surge Pond but would not have ended them. An overflow in 1990 as the result of rainfall during the construction of the elimination of the Dead Creek Surge Pond demonstrated this.

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ASTORIA, MISSISSIPPI RIVER
HARBOR



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MISSISSIPPI RIVER
EASTERN INNER HARBOR

Legend	Scale	North Arrow
1. Road	1:10,000	North
2. Railroad		
3. Industrial Structure		
4. Building		
5. Water		
6. Land		
7. Other		

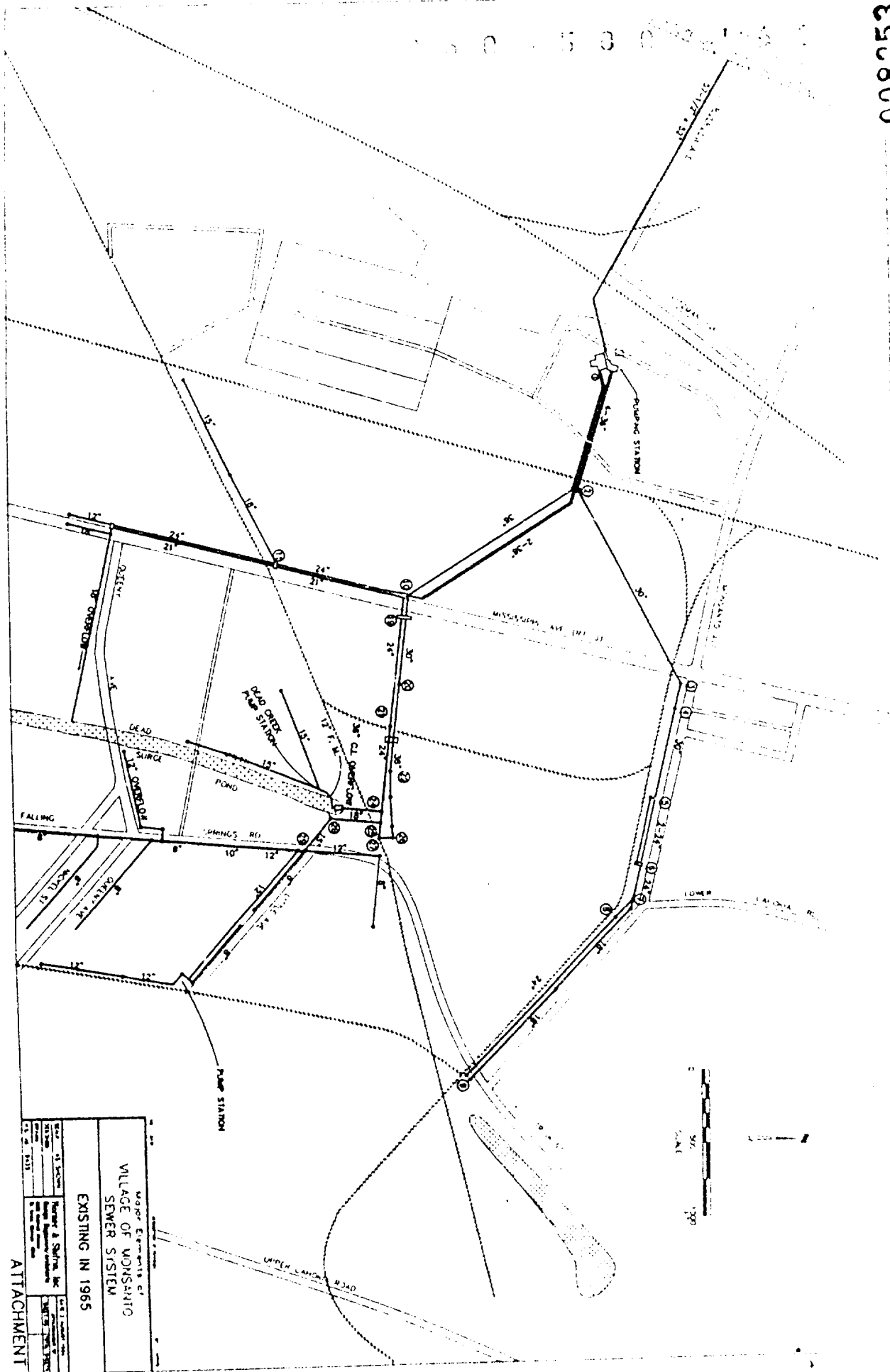
Scale
1:10,000

North Arrow

06500316



Major Elements of VILLAGE OF MONTICENTO SEWER SYSTEM			
EXISTING IN 1952			
NAME	OF PROJECT	DATE	BY
Monticento	Monticento	1952	1952
DESIGNED BY	Monticento	1952	1952
CHECKED BY	Monticento	1952	1952
APPROVED BY	Monticento	1952	1952



ATTACHMENT "D"